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Propulsion provides 'push' into space

by Ranney Adams, Propulsion Directorate

EDWARDS AFB, CALIF. — It has been 30 years since mankind first stepped onto the moon's surface. One of the key technologies that enabled those Apollo flights to the moon were the massive rocket engines that propelled the Saturn V and its human explorers.

The F-1 rocket, designed and built by Rocketdyne, developed 1.5 million pounds of thrust, and the Saturn had five of them for the first stage of the 300-foot tall rocket. Derived from earlier Air Force research efforts, they each gulped three tons of kerosene and liquid oxygen a second. Before the first flights of Apollo, engineers had to assure themselves that the liquid rocket engines would operate properly and provide the power necessary to "push" man to the moon.

This entailed many months of tests and trials at a remote site on the edges of the Mojave Desert. A modified ATLAS rocket test stand at the Air Force's Rocket Propulsion Laboratory was used for the initial tests. Rocketdyne's engineers spent their time ensuring that the fuel and oxidizer mixtures for the engine were just right. Using developing technologies from the lab, they were able to pump the massive amounts of these liquids into the engine. These research and development tests made sure that all the components would withstand the rigors of flight while they generated the propulsion for America's dream. While the lab's test stand 1A was being used to finalize the engine design, five more test stands were built and used to provide the proof that they would work.

These efforts would evolve into more than 5,000 production tests of the rocket engines that would be used for the Apollo flights, ending with the Apollo–Soyoz docking in space in the early 70s.

For more than 50 years, this 65 square mile research facility overlooking the massive dry lake bed at Edwards AFB has been providing the rocket propulsion concepts, technologies and validations for America's military, civil and commercial rocket propulsion systems.

Known today as the Air Force Research Laboratory's Edwards Research Site, the lab facilities are the workbench for the lab's Propulsion directorate and several industry partners. Its test stands continue making their contributions to man's "push" to space. Current major efforts include Boeing-Rocketdyne's new RS-68 liquid rocket engine that just completed its first 100 percent power tests. Generating 650,000 pound of thrust on the modified 26-story high Test Stand 1A, it is intended to power Boeing's Delta Four expendable rocket for commercial and military payloads.

With the lab's vast knowledge of solid rocket propulsion stemming from the nation's first segmented solid booster developments and tests in 1975, a national need arose in 1987 to validate the boosters used with the Titan heavy lift launch vehicle. Test Stand 1-C was formerly one of the F-1 rocket engine production test stands. To answer the need, it was converted into the nation's first vertical test stand for the huge solid rocket boosters. Those tests were successful despite initial mishaps.

Today, personnel are busy preparing the stand and a new 11-story high solid rocket booster for a validation test this fall. The booster weighs 750,000 pounds and generates 1.7 million pounds of thrust. The test will assure their customers that the rocket performs properly with a new rocket nozzle made of improved materials,

Seven miles away and adjacent to the lab facility's border, Lockheed Martin Skunk Works personnel and their subcontractors are putting the finishing touches on NASA's X-33 Reusable Launch Vehicle launch site. This technology demonstrator incorporates new thermal protection systems, composite cryogenic tanks for liquid oxygen and hydrogen and a propulsion concept that evolved from the lab more than 35 years earlier, the aerospike engine.

Between these sites are many more unique facilities generating future technologies for tomorrow.

The lab's personnel and their industry partners are guided in their tasks by a master plan for rocket propulsion called Integrated High Payoff Rocket Propulsion Technology. Its purpose is to set the goal and milestones for doubling the nation's rocket propulsion capability by 2010. Those goals include enhanced reliability, performance and reduction in costs for all sorts of propulsion systems.

A peek at that future includes: High Energy Density Materials, or super-propellants for tomorrow's rockets; solar propelled rockets and electric propulsion concepts to maneuver and maintain satellites in space; and, even laser propelled launch vehicles.

While man has not returned to the moon, researchers at the lab's facilities have not stopped their work, providing tomorrow's or propulsion needs. **@**